

REPORT ON SECOND INTERNATIONAL SYMPOSIUM ON "BASIC ENVIRONMENTAL PROBLEMS OF MAN IN SPACE".	
14-18 June 1965, Unesco House, Paris	
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Washington, D.C.	

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28 June 1965

REPORT ON SECOND INTERNATIONAL SYMPOSIUM ON
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A. GENERAL CONSIDERATIONS

1. The organization of this Second International Symposium on Man in Space was, in many ways, not carried out as efficiently and effectively as was the case of the First Symposium in 1962. When, in the fall of 1963 a group of the original study and organizing committee members met in Paris at the IAF Meeting to consider the possibility of holding a Second Symposium, a number of basic requisites were laid down as being essential to the scientific success and value of such a Second Conference. These points, strongly emphasized and agreed upon by all parties concerned, including Prof. Sissakian, the Soviet member, were as follows:

- a. General review papers were to be kept to a minimum with maximum allowable being no more than one to introduce the three principle areas for discussion; i.e., Ecophysiology, Psychophysiology and Engineering Psychology; Biotechnology and Special Man-machine Problems.
- b. The body of the Symposium was to consist of solid scientific or engineering reports on specific projects or studies, with objective data and results being presented in full detail.
- c. The papers to be presented were to be completed some six to nine months prior to the actual Symposium and distributed to the invited participants and also to specific individuals who would lead the discussion period following each presentation.

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- d. The underlying philosophy of the entire projected proceedings was to use the formal papers as merely platforms on which could be mounted a very active and extensive exchange of views and ideas on each area of work or study presented. Ideally, it was hoped that a considerable amount of work as yet unreported in the literature would be discussed by the individual participants, allowing them almost an equal opportunity for expression as the formal presenters.

These basic requisites laid down in 1963 were never realized and although there was more time allowed for discussion in this Second Symposium, no one had been able to peruse the papers prior to appearing at the conference and, since most of the lectures were given in summary form, it was rather difficult to become very specific in putting questions to the speakers.

2. Retrospective fault-finding as regards the organization of the Second Symposium offers little of value to this report and I would personally opine that the factors principally responsible in its failure to achieve the high scientific standards originally set in 1963 were the following:

- a. The absence of Theodore von Karman's strong international influence and leadership which was constantly in evidence throughout the preceding and actual events of the First International Symposium. The Professor had unique powers of persuasion which he used with great effectiveness, albeit not always in accordance with strict ethical standards, to keep a mixed group of internationalists working together strenuously to meet the stated objective. It is not likely that we shall find his equal for some generations to come.
- b. Frank Malina, a very close friend and working partner of von Karman, has in the past always exercised a very decisive role in implementing all plans and ideas

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generated by the Professor, but since the latter's death, Frank has to a certain extent retired from active participation in both the IAF and the IAA activities. His presence and influence on the Parisian scene is still beneficial to such activities as the Symposium but his primary interests in life now are centered around the furtherance of his career in the field of kinematic art forms.

- c. The two Vice-Chairman of the Organizing Committee, Lovelace and Sissakian, have both been exceedingly busy in their respective jobs with multiple and varying demands competing for their time and energies. To my knowledge only one meeting of the Organizing Committee was held during the period of September 1963 to the actual opening of the Symposium and this situation placed almost an insurmountable burden upon the Chairman, Dr. Hilding Bjurstedt of Sweden. However, in characteristic fashion, he accepted this considerable responsibility with dogged determination and unselfish devotion to the objective, the successful attainment of which must largely be attributed to his own individual efforts.
- d. The financial backing for this Second Symposium was on much shakier grounds than was the First and again this is probably due to the absence of Von Karman's persuasive voice and hands in the matter. Whereas in the previous instance, Unesco had provided for a fairly generous working budget which allowed transportation and living costs to be paid to the principal participants (if they needed it), on this occasion the funding was quite austere and I doubt that anyone had their way paid other than Dr. Bjurstedt himself and possibly his secretary, Miss Irene Unander-Scharin. In discussing this particular aspect of the Second Symposium with Dr. Stark Draper, President of the IAA and Dr. Frank Malina, I learned that the Academy itself is in fairly severe financial straits and unless some additional funds are obtained in the next several years, its future survival as an authoritative and effective international working group in the area of astronautics may be seriously threatened.

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3. A minor crisis occurred during the several week period just prior to the Symposium when Dr. Lovelace, Co-Chairman and nominal leader of the U.S.A. delegation, called me to say that his doctors would not allow him to attend the Symposium. He discussed various possibilities as regards finding a proper (NASA) substitute to present his paper (which it later turned out did not exist in final form as yet) and he was inclined toward Dr. Sherman Vinograd, his acting Deputy in the NASA Washington Office, as being the most likely substitute. I pursued this matter informally with Dr. Vinograd and learned that he was scheduled for a rather extensive European trip which did not include the Symposium. However, he was willing to hold over if Dr. Lovelace did in fact appoint him as a substitute. It is possibly of some interest to the professional collecting people to point out that this turn of events was viewed with particular alarm and foreboding by friend, Boris Mandrovsky of the Library of Congress, who had been more or less designated by Dr. Lovelace as his official interpreter with the Soviet scientists and Boris was understandably quite concerned over the matter of his designated alternate. If someone was named who either did not know Boris or who did not share Dr. Lovelace's high regard for his talents, capabilities and objectives, then he would indeed be placed in an extremely difficult position. However, it all turned out well in the end. I called Dr. Lovelace and recommended that he officially appoint Dr. Ashton Graybiel of the U.S. Navy at Pensacola as his alternate, emphasizing the fact that Dr. Graybiel enjoyed a position of stature and prestige on the international bioastronautic front that was second only to his own, and therefore was best qualified to fill his shoes at this important function. The deal was therefore consummated and since he had worked successfully and harmoniously with Graybiel on past similar exercises, Mandrovsky reverted back from his state of acute hysteria to his normal one of simple hypermania.

4. In the interest of historical completeness in reporting all events surrounding this particular Symposium, I should perhaps mention briefly another incident which might properly be titled as "The Purloined Gemini 4 Film" or "How good-guy Frutkin saved NASA's International Image from the machinations of bad-guy Flickinger". The script is a fairly simple one but apparently (and inadvertently) I gave Arnold Frutkin, in his position of final authority in all matters

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dealing with NASA's international interfaces, some rather bad moments; in fact it is not completely out of the realm of possibility that he may have put an unfavorable report into the system as regards my personal actions in this matter. At any rate, as has been my custom in the past whenever I am about to make an overseas trip I checked with some good friends of long standing in the NASA Headquarters Film Library to see if there were any current space flight films which had been released that I might take along on the Paris trip to show to interested groups, not only in Paris but also in London and Brussels. On Thursday, the 10th of June, I was at the Film Library returning two films that I had taken along with me on my recent trip to the Far East. In response to my inquiry regarding any new and interesting film being available, I was told that they were expecting three prints of the GT-4 flight up from Houston on the following day and if I would come back they would try to make one of these available for my use, since it would have the colored strip showing Ed White on his extravehicular walk into space. I asked if anyone else from NASA was planning on taking the film to Paris for either the Air Show or the MIS Symposium and they said that there were no such plans to their best knowledge. On the following morning I received a call from my friend saying the film was due in around 1300 and he would have it ready for me anytime after that. I thanked him and he asked if I would check the matter out with Mr. Frutkin's office just to make everything legal. I replied that I would be glad to and after hanging up, placed a call to Frutkin's office. Upon identifying myself to his secretary and being placed on hold for several moments, she came back on the line to tell me that Mr. Frutkin would be tied up most of the day but would try to return my call later on in the day. I said fine. Around 1430 I proceeded to FAA in order to complete some work that I had been doing as a member of an Ad Hoc Advisory Group to Mr. Halaby, instructing my secretary to tell Mr. Frutkin the nature of my call as regards the film in the event that he returned my call during my absence. The work at FAA took longer than I had anticipated, so that I was late getting by the Film Library where I was given the film and also late in getting to my office. Upon returning my secretary informed me that Mr. Frutkin's secretary had called back in my absence and asked to know the nature of my business with Mr. Frutkin, using a conversational tone and manner which my secretary described as being unfriendly to the point of outright rudeness - such as she had never before in all her phone conversations experienced.

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She related the gist of my message to Mr. Frutkin's secretary who then hung up. Shortly thereafter, Mr. Frutkin himself called back for further details and she filled him in with as many of them as she knew, whereupon Frutkin asked that I call him upon my return to the office. She told him that I was somewhere either in FAA or in NASA and that in the event that I was late getting back in the office that I would be there all the following morning (Saturday) before leaving for Paris. By this time it was after 1700 which is normal close of business for government offices in Washington and my call to Frutkin's office yielded no response.

I proceeded then to Paris with the film, having heard nothing further from Mr. Frutkin on Saturday morning and on Monday morning, the 14th, I told Dr. Graybiel and Prof. Bjurstedt that I had the GT-4 film with me for whatever use they wished to make of it, if any, during the Symposium. Since I had not taken it to view the film before leaving, I arranged to have a projector set up and gathered together five or six of the U.S.A. delegates to view the film which we subsequently did and all agreed that it was indeed an excellent film and should by all means be shown during the meeting. Prof. Bjurstedt asked when I wished to show it and I told him that I would wait until Dick Johnston of NASA Houston arrived since he could narrate the film properly. I also pointed out that since the Soviets were apparently being delayed, that I was sure that Dr. Graybiel and Dick Johnston would not wish to show it until they (the Soviets) were all present. That evening around 2100 I received a transatlantic call from Dick Johnston in Houston asking whether or not I had shown the film yet and I told him that I had not except to preview it with a few of the American delegates and he evidenced considerable relief, saying that he had had a call from Frutkin on the matter and was currently redoing his paper to include the film as a part of his presentation. I told him that such was fine with me because after all it was a NASA film and I had already announced my intention to save it until his arrival for his personal narration anyway. He asked me to tell Capt. Walton Jones that he would be delayed getting in until Wednesday and I told him that I would be happy to do so.

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The following morning I contacted Walton Jones and gave him the message regarding Dick Johnston's late arrival and told him also that I would turn over the film to Mr. Jeff Lindsay who was representing the NASA Manned Space Flight interests at the Symposium and he said that was fine with him. I then ran down Jeff Lindsay, apprised him of my conversation with Dick Johnston and asked if he would accept the film for safekeeping until Johnston's arrival. He said he would be glad to do so and added that he had been in the office of the Paris NASA representative, a Mr. Owsley, that morning when Mr. Frutkin had called from Washington evidencing considerable concern about the film being in my hands and asking that it be taken over by Mr. Owsley for safekeeping until Mr. Johnston's arrival. Lindsay said to me that he did not quite understand what all the fuss was about but that he would report to Mr. Owsley that the film was in his safe hands. Dick Johnston arrived Wednesday and apologized to me for the mixup about the film but I told him there was no sweat; that I was only trying to assist in the overall American showing at the Symposium. He had brought a shorter version of the film which I had received from NASA Headquarters and this he showed with great impact as a part of his presentation on Friday.

Meanwhile, apparently coinciding with LBJ's decision to send the two Gemini astronauts and the Vice President to bolster up the weak showing of the U.S.A. at the Paris Air Show, the USIA obtained the film which I had brought over from the Lindsay-Owsley Axis and were showing it throughout the day at the Air Show, with such apparent success that they refused to return it to Lindsay when he was ready to leave Paris. He apologized to me for not being able to return it to me so that I could show it in London and Brussels but I assured him that my principal objective had been achieved with Dick Johnston's talk and film showing and what subsequently happened to the film which I had brought was a matter entirely up to NASA's decision with my personal responsibility ending when I turned over the film to himself. Thus, the "Case of the Purloined Film" ended on a happy note for all concerned and NASA's International Image remained untarnished.

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STAT**B. OPENING CEREMONIES AND OTHER PRELIMINARY EVENTS.**

1. The participating delegates began to assemble, register and receive their packages of pre-prints and translated summaries in English, French and Russian. From the list of registrants it appeared that there would be only about fifty to sixty per-cent as many in attendance as had appeared at the First Symposium in 1962. However, the key delegates from the various European free and satellite nations comprised the same individuals as had attended the previous exercise. This fact provided for an initial feeling of solidarity and good-neighborliness amongst the heterogeneous group which served the basic purpose of the meeting very well indeed, providing as it did, for an air of relaxed informality throughout all the proceedings and fostered a greater abundance of high-spirited discussions and repartee during the question and answer periods. By the time the Symposium was formally adjourned on Friday, about half of the delegates were referring to each other during the discussion periods on a first name basis - like all one, big, happy family.

2. The complete absence of any Soviet delegates at the Monday morning registration session was quite obvious and the rumors of course were flying thick and fast-ranging in typical fashion from the sublime to the ridiculous, the latter being represented by the positive statement made by one of the U.S.A. delegates to the effect that he had learned from an ^{un-}impeachable source in the Embassy (not specifying which Embassy) that the Soviets were going to boycott the entire Symposium because of the striking success which we had achieved with our recently completed GT-4 flight. Before the opening ceremonies began at 1100, Bjurstedt had told me that the Soviets were delayed because of transportation difficulties but that he expected them to appear during the noon hour. Actually, they did not appear until Wednesday the 16th, their story for the delay being that the French had not seen fit to process their visas until late Monday afternoon and with the constraints imposed upon them in travelling AeroFlot outside the U.S.S.R., this meant that they could not leave Moscow until 0300 on Wednesday. This accounting for their delay in appearance turned out to be factual except for the slight omission of the additional information to the effect that their called request for visas had not been received by the French until mid-afternoon on Friday, leaving no working time for the French to process their requests and return them before the place shut down for the week-end.

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3. Prof. Hilding Bjurstedt, Chairman of the Organizing Committee, formally convened the Symposium and made the following remarks. The purpose of this Second Symposium was basically the same as had been set for the First, namely to further advances in the Life Sciences towards the objective of assuring the safety of man in his personal exploration of space; such to be accomplished through the stimulation and intensification of our efforts to cooperate and collaborate on an international basis in the fields of education and research. He reviewed the history of these two Symposia and paid tribute to the work of the members of the Organizing Committee with a special tribute (and well-deserved indeed) to Helene van Gelder, the corresponding secretary to the IAF-IAA home office in Paris. He announced publicly that the Soviets were delayed in their arrival but that they were expected to appear for the afternoon session. He closed by saying that despite the extremely rapid strides and progress being made in space science, technology and manned space operations, we, as life scientists, must constantly be mindful of our grave charge of responsibility to all of mankind in following the strict ethical precepts of our respective professions and assure that humanity, present and future, would be best served. Only, he continued, by actively pursuing a policy of increasing and expanding our current program of inter-nation scientific information exchanges, could we hope to satisfactorily discharge this deep moral responsibility to our fellow men.

4. Mr. Matveev, speaking for Mr. Megorott, Director-General of UNESCO. He has followed with great interest the activities of both the U.S.A. and the U.S.S.R., in manned exploration of space and has been particularly impressed with the great progress which has been made in such a short interval of time as has passed since the first Symposium in 1962. He commented upon the three-man flight of the Soviets and the extravehicular activities carried out by Leonov and White, pointing out that our own activities in the Life Sciences were largely responsible for these notable achievements being recorded on both sides. It is inevitable, he opined that man will travel to the moon and beyond, some day even making another "home for himself in the stars." However, he warned, that there are many complex problems which must be solved before we can safely take these next steps to the moon and beyond, and therefore this particular Symposium, dealing as it does

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with these urgent problems of man's function and survival in space assumes timely and great significance and importance. As in the past, UNESCO fully endorses and encourages international cooperative scientific and technical programs where useful and timely information can be exchanged and he trusts that this one about to begin will fulfill our most lofty aims and objectives.

5. Prof. E. A. Brun, Past President of the IAF speaking for himself and for Dr. W. H. Pickering, Current President of the IAF. He spoke at some length partially from written material and partially off the cuff, in French, although when I talked with him personally before the meeting I noted that his command of English had improved considerably since I had last seen him in Paris in 1963. Since his speech covered a fairly broad range of subjects, I shall economize on space and reader's time by summarizing the principle points in the following outline fashion:

- a. Expressed both his own and Dr. Pickering's sincere thanks to UNESCO, WHO, ICAE, WMO, ITU and the French Academy of Astronautics for the support and encouragement they have given to this Symposium.
- b. Stated that Space Exploration had become a world-wide endeavor with all nations either participating directly or indirectly and therefore it was mandatory that we expand our international cooperative efforts on an increasingly broader front. In this endeavor, he pledged the continued active support from both the IAF and the IAA, and with the help and cooperation of these other international groups (paragraph 'a' above), he (Pickering) pledged his efforts to continue these series of Symposia. The First meeting in 1962 had been such a marked success that the Chairman, Dr. Bjurstedt had been asked to continue his efforts into the Second and his great efforts were deeply appreciated.
- c. Remarked on the truly astounding progress that had been made since 1962 and cited the Voskhod and Gemini flights

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along with advancements made in space suit technology which made possible the extravehicular activity of White and Leonov as typical examples, paying tribute to the strenuous efforts being made by all life scientists in meeting these complex and urgent problems in a timely and effective fashion. He continued saying that the immediate ends achieved by both the Voskhod and Gemini flights in themselves alone fully justified all of the time, effort and money which had gone into their fulfillment. However, he pointed out that in addition to this obvious fact of the immediate ends fully justifying the means, there were untold areas of new knowledge and technology which came out of these tremendous achievements which could readily be extrapolated to other more earthly bound problems which mankind was facing. Certainly there were immediate, very substantial side benefits being realized in the fields of medicine and transportation, with many many more to come which were not apparent to us at the present time.

- d. Although between us we had succeeded in putting up more than three hundred earth satellites since Sputnik I, the Space Age was still in its barest infancy. Voskhod and Gemini had proved beyond any doubt that man properly protected could survive in space and now we must concentrate on proving man's complete functional capability as an on-line component of the total space exploring system. There can be no question regarding man's essentiality in the system but it remained the primary challenge of the Bioastronautics Community to research the wide range of integrations possible between man, the machine and the environment, establishing reliable configurations which will fully exploit man's unique capabilities in the total system. While this represents (to you all) a challenge of unprecedented proportions and complexity, he is assured that by continuing our individual efforts and working always

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toward more truthful and fruitful international collaboration and cooperation as is represented in this current meeting, we shall meet this challenge and realize this great opportunity that is afforded us to make one of the greatest contributions of all times.

6. Dr. C. Stark Draper, President of the IAA. Others have discussed the organization of effort and the various contributions made and he would like to highlight some of the specific high points of achievement recorded by the space scientists, engineers and the astronauts themselves. Space technology has demonstrated a proven capability of putting two-three men into space with precision and reliability of all systems proven to a point where the risk factor has been reduced to "quite reasonable and acceptable levels." Although we have been beset in the past by many pessimists and unbelievers who have constantly highlighted the many serious problems and obstacles to Space Exploration, in practice and at the hands of highly motivated workers, practically all of these difficulties and impossibilities have vanished. The astronauts and cosmonauts have conclusively demonstrated that there is nothing as yet mysterious about space as a real threat to man's thinking, observing, judgments and action in the space environment and it is up to us to provide the technology which will enable them to fully exploit the full range of human capabilities. Our job then in the immediate future is to provide the astronauts with longer duration reliable life support systems, better communications and remote control equipment specifically designed toward the complex task of rendezvous and docking, all of which is a vital step in bringing about a successful lunar landing. The events which lie ahead of us in man's exploration of space are beyond our imagination but there is every reason to believe that, as in the past, true international cooperation will insure that all things to come will directly enhance the future welfare of all mankind. He wished us all success in the completion of our Symposium work at hand, and urged all delegates to continue their past exemplary efforts to promote even greater international exchange of ideas and information in this important and vital field of Bioastronautics.

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C. SUMMARY OF THE TECHNICAL PRESENTATIONS. (A complete set of all papers presented is on file and being given wide distribution by NASA and other responsible agencies. The presentations herewith are listed in their actual order of being given, and not as they appear on the program, since it was completely revised when the Soviets failed to appear on the opening day).

1. Vestibular Problems in Space Flight by Capt. Ashton Graybiel was substituted for the paper to be originally presented by Dr. W. R. Lovelace, II. Dr. Graybiel reviewed the anatomy and function of the vestibular apparatus and also the work which had been done by his group using the rotating room technic. Motion sickness of varying degrees of severity can be induced in practically everyone depending only upon how fast the room is rotated and how rapidly they move their head during the rotating field. Some tolerance through exposure and experience can be built up and in addition their results indicate that tolerance to increased head movements can be improved significantly with amphetamine. Semi-circular canal function must be intact if motion sickness is to be induced and the accessory or contributory role of the otoliths and other sensory inputs in producing the disability is not precisely known. In their work, studying labyrinthine defective subjects with normal controls, the factor of fear and apprehension appeared important.

Discussion: The point was raised that the terminology which is used in describing vestibular function and disturbances is very confusing and Dr. Graybiel agreed but had no solution to offer.

The question was asked as to why some astronauts describe the sensation of floating upside down shortly after insertion into the zero G state of orbital flight while others apparently have not experienced it. Dr. Graybiel said that this was true and that it apparently depended upon the individuals use of visual clues and the degree of his fixation into the couch.

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2. Prof. Carl Johan Clemedson of Stockholm read his paper on Bio-ecological and Bio-medical Monitoring for Advanced Man in Space Projects. This was somewhat of a philosophical, general review type of paper which did not represent any new work being done. He made reference and paid deference to the early work of Von Diringshofen of the Netherlands, who in 1933 first proved the practicality of telemetering EKG and respiratory rate from aircraft. He also cited the pioneering work of Roman and Lamb in the U.S.A., who have demonstrated that it is quite possible to carry out extensive biomedical monitoring during operational flights without restricting pilot function'. He dwelt at some length on the matter of continuous sampling of the capsule atmosphere to detect rising concentrations of trace contaminants and discussed the possibility of using such technics as gase chromatography, infra red and mass spectrometry to carry out this particular monitoring function. He stressed the urgent need to have one physician along on all group flights so that his clinical observations and tests could augment the recorded and transmitted biomedical data. In closing, he pointed to the very urgent requirement currently extant to develop an integrated personnel monitoring system which will give valid and predictive information on the present and future performance capability of the space crew.

Discussion: none

3. Air Commodore W. K. Stewart discussed Some Problems of Behavior Relating to Space Flight. The behavioral aspects and problems attendant to long space flights present some extremely challenging and difficult questions. He feels that some of the answers may be found by pursuing more actively our use of mathematical models, despite the fact that we do not have good co-efficients or numbers to quantitatively describe neurogenic stress. He also commends our study of the so-called higher mental functions and cites the alterations in 'time perception' which is noted in experienced fighter pilots when they are performing a complicated tracking task. He also felt that a study in greater depth of what he termed the 'sensory background' might prove useful in providing a greater understanding of these behavioral problems. Some senses such as sight, taste, smell and hearing have built in memory systems and perhaps

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we should look into the possibility of the equalibratory senses having a similar background memory which could explain some of these illusionary and disorientation phenomena.

Discussion: Grandpierre of France cited some of the un-explained disturbances in sensory-motor function observed during the flight of their space kitty which he related somehow to the topic of 'sensory background'.

Gauer of Germany cited some old animal work which showed that, using special technics in varying blood flow and mean pressures into a muscle mass, the gamma muscle spindles could be conditioned to perceive extremely low values and rates of positive G onset.

4. Earl Wood of the Mayo Foundation gave one of the best papers of the Symposium in which he described the work they have done on a large series of dogs to more fully elucidate the Cardiopulmonary Effects of Acceleration. Their work showed the oxygenation in the lungs begins to drop off even at the 2G level and continues to decrease as the force environment increases with the mode of action being predominantly that of a pulmonary arterio-venous shunt. At 5 G, in all subjects, there was evidence of collapse in the dependent portions of the lungs. He pointed out that the vasomotor regulatory mechanism in the pulmonary circulation of the dog was quite similar to that in man (although the same does not hold true for the systemic circulation) and therefore it was reasonable to believe that these same mechanisms observed in their dog subjects would also take place in man under similar force environments.

Discussion: Grandpierre of France discoursed somewhat in the philosophical vein, pointing out that precise studies of cardio-respiratory control and activity were difficult to carry out even under normal conditions because of the dynamic interrelations of the two systems, and when one added to this picture and extrinsic force environment, then the problem of accurate measurement of continuous values was compounded tremendously.

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5. The interesting topic of Fluid Metabolism and Circulation During and After Simulated Weightlessness was very well presented by Otto Gauer, who is one of the best research physiologists in the field. He theorizes that although the neurohormonal, pressure and volume control mechanisms operating to maintain fluid balance represents an extremely complex integrated control mechanism, nevertheless our present knowledge, if applied properly to the problem of cardiac de-conditioning in the weightless state, should prevent such from occurring. He suspects that the true effects upon the circulation and fluid balance as occur during weightlessness lie somewhere between those effects observed after water immersion and those elicited during prolonged bed rest. He emphasized the fact several times that unless the astronaut is adequately hydrated during the zero-gravity exposure, any changes noted post-flight in the orthostatic tolerance will not yield to accurate evaluation. In conclusion, he states that the big question is that concerning the feasibility of using inflatable cuffs and muscular exercise in an extent and to a degree required to replace the longstanding effect which natural gravity has had upon the circulation.

Discussion: Grandpierre of France asked how Gauer reconciled the cosmonauts loss of weight with the decrease in urinary output and he replied that it was an extremely involved problem requiring the accumulation of a fairly large body of data, and that he personally had not seen such data on any of the space crews. Gauer referred the question to Dr. Stan White, who stated that such studies were not made on the American astronauts because of mechanical difficulties in the urine collection device. Someone pointed out that from the Soviet reports, their cosmonauts did have a diuresis which occurred during the first eight to ten hours of flight and then stabilized.

Gauer was questioned on the relationships between plasma volume and weight loss in the subjects undergoing water immersion and he replied that plasma volume changes could account for only about half of the observed weight loss and this made the assessment very difficult.

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Stan White asked Gauer if he felt that tilt table studies pre- and post-flight were useful or harmful in attempting to study this problem and Gauer said that he was violently opposed to the use of the tilt table when the subject was slung up in a parachute harness but when properly used with a foot-board, he thought it had some value.

6. Professor Walawski presented some original work done in collaboration with Dr. Kaleta on Vascular Reactivity to Neurohormones in Subgravity Simulated by the Immersion Method. From their data they advanced the interesting thesis that any changes in the vascular reactivity observed during or post-flight in the astronauts must be of emotional origin and mediated through the vegetative nervous system. In their human subjects, kept immersed for twenty-four hours, they had observed no changes in vascular reactivity to the neurohormones, i.e., noradrenaline, acetylcholine, histamine and serotonin. They concluded therefore, that no changes thus far observed in the astronauts could be directly related to the purely mechanical factor of weightlessness and therefore we were a long way from understanding the total cumulative effects of prolonged weightlessness.

Discussion: Gauer of Germany said that he could not agree at all with their conclusions which ascribed all circulatory and other changes observed to a variation in emotional factors. Walawski referred to the early work of the Soviets in which they compared a normal with an anesthetized dog during rocket flight and found very little, if any, changes from the ground control values in the anesthetized dog whereas the normal dog showed the typical response pattern during the noisy and powered phases of the flight.

7. The most interesting topic of the entire Symposium (to me at least) was presented brilliantly by Dr. Cornelius Tobias of the University of California Donner Labs, in his paper titled Interactions of Radiations and other Environmental Stresses on Biological Systems. This fine paper contains such an abundance of good material that it would be highly presumptuous of me to attempt any reasonable summarization. Suffice to say, his group have evolved new techniques and biological preparations which are allowing them to determine for the first time, the additive effects of a wide

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variety of environmental stressors superimposed on biological systems which have been exposed to varying degrees of sub-lethal (long-term) ionizing radiation. Tobias points out that they are only just beginning this work, having spent a good deal of time perfecting their methods and design of the experiments but he is very optimistic that as they get into it, many of the past mysteries of synergisms and antagonisms between stressors operating at cellular level will be partially cleared up by their results.

Discussion: none (This was somewhat surprising although, of course, the Soviets were not yet in attendance.)

3. Tolerance to the Combined Effects of Hypoxia, Hypothermia and Ionizing Radiation was presented in very excellent fashion by Prof. Andjus of Belgrade, Yugoslavia. Using tracheal occlusion to produce very sudden and rapid hypoxia and body cooling to 15-16 degrees centigrade, he studied the single and combined effects of these two insults upon the survival rate in animals exposed to 1700 roentgens irradiation. In his series of protocols, he showed that although hypothermia per se gives some significant protection from lethal doses of ionizing radiation, the combination of acute hypoxia and body cooling, if applied prior to the radiation exposure, increased the survival rate by three-fold.

Discussion: An unidentified participant asked Andjus if he had drawn any conclusions from this work regarding its potential applications to space flight and he replied in the negative. Professor Novak asked if he had studied the efficacy of chemical prophylaxis against ionizing radiation as a part of this work and Andjus replied that if the questioner had followed his presentation with even reasonable understanding, that he would realize that chemical prophylaxis had nothing to do with the experimental design. (For some reason or other these two always have a go at each other any and everytime they are on a program together and poor Novak always comes off a very poor second - he, nor for that matter few others, can match wits or scientific acumen with Andjus and come out even on the exchange.

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9. Dr. P. Groghot of CERMA, Paris, France reported out a neat little paper on The Biologic Effects of Vibration at the Cellular Level. Peritoneal tissue cells were exposed for thirty minutes to vibrations at 4 & 7 CPS, with the mitotic processes being studied at 30 second intervals. They found the critical time exposure threshold to lie somewhere between 4-7 minutes beyond which there was uniform mitotic anomalies observed in the anaphase. Once these changes occurred, the tissue culture proceeded to develop morphological structure which they termed as pre-neoplastic. They were not able to elucidate, in this study, clearly the mechanisms underlying the alterations observed in the anaphase as a result of the vibratory exposure.

Discussion: none

10. Dr. L. Miro, also of CERMA, reported on the Effects of High Frequency Electromagnetic Fields on the Methionine S-35 Uptake by the Liver and Spleen of Mice. These workers exposed mouse tissue (spleen, liver and thymus) in a high frequency electromagnetic field (1.5 Gauss) for seven days and studied the uptake of methionine S-35 in comparison with unexposed controls using histo autoradiography (measurement of optical density of tissue slices) to determine the amount of uptake. They found a statistically significant increase in the uptake values for the methionine in the exposed tissues which they interpreted as positive evidence that protein synthesis had been accelerated by the applied EMF. However, they stated that their techniques did not allow them to determine whether it was the lymphoblasts or reticular cells which were responsible for the increase in protein synthesis.

Discussion: Prof. Nello Pace, U.S.A., asked whether or not a 'heating effect' had been produced by the EMF which might account for the observed changes and Dr. Miro denied this, stating that there had not occurred any demonstrable heating effect from the exposure.

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11. Prof. J. Ernstine of the RAF, Farnborough discussed the Toxic Effects of Breathing Oxygen and presented evidence that breathing 99% oxygen for a period of three hours caused a significant reduction in the diffusion co-efficient of the lungs; that breathing 100% oxygen during the execution of hypergravic (4 G) aerobatics resulted in a marked decrease in vital capacity and the subsequent X-ray appearance of small areas of pulmonary atelectasis. He further stated that 14-day human exposures to 100% oxygen at one-half atmosphere pressure resulted in a reduction in erythropoiesis with significant reduction in the RBC of peripheral blood. After they had experienced a fire during one of these 100% oxygen exposures, they did a lengthy study on the various factors which underlay the propagation of such fires and the extent of eventual injury received, using hogs as subjects and a wide variety of materials and methods of wrapping the body. He demonstrated this part of his presentation with a rather dramatic movie showing a fair number of hogs being barbecued. He cited the need for an instantaneous engulfment of the subject with a heavy water shower if serious burns were to be prevented. He further made the case for wrapping the body with a light, porous fire-resistant gauze prior to donning the outer garments as being the best method of preventing widespread flash burns before the fire could be brought under control by the water shower.

Discussion: In his characteristic high Gallic dudgeon, Gen. Grandpierre called Ernstine fairly severely to task for not citing the extensive work done by the French and Italians on the problem of oxygen toxicity. The good French Flight Surgeon did not have any slides in his pocket but he spoke almost as long as Ernstine had on the findings of both the above-mentioned schools of workers. Basically, he pointed out that some years ago they had demonstrated that breathing 100% oxygen resulted in irritative effects to the lung tissues, depressant effects upon the hematopoietic organs and reflex effects upon the cardiovascular system. Ernstine accepted the criticism and subsequent comments in typically British stoical fashion, apologizing for the fact that the severe limitations imposed upon his time for the presentation had precluded his citing of the past work which had been done in the field by many excellent workers, including the French and the Italians.

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Note: At this point in the program the Soviet Delegation arrived at UNESCO House, 1100 Wednesday 15 June 1965, signing in in the following order: V. N. Chernigovski, G.M. Frank, A.V. Pokrovsky, V.A. Popov, A.M. Tolokhov, A.I. Vorobriev, V.M. Vasiliev and A.M. Guenin. The program was then re-adjusted to allow the Soviet papers to be given consecutively until they had caught up with the program as of Thursday afternoon, from which point the presentations continued as originally scheduled. Since copies of the translated full text of all Soviet papers presented is appended to this report, and further since the actual Soviet presentations were capsule summaries, I shall not attempt to discuss each presentation in any detail. Where there was a significant question asked and answered, I shall mention it.

12. Prof. Chernigovski read the paper which was to be given by Prof. Sissakyan, for whose absence the former briefly apologized. The title of the paper was Some Ecophysiological Problems in which the author described Ecophysiology as a new complex of biological disciplines brought together to study the peculiarities of vital processes and behavior of live organisms exposed to rocket flights and space environments. He emphasized the need to conduct intensive study of living processes at cellular, sub-cellular and molecular levels under actual and simulated conditions of space flight, in order to understand (and enhance where feasible) the adaptive and protective biological mechanisms at work. Extensive laboratory modelling (simulation of lunar and planetary environments is urgently needed if we are to establish the design criteria and ecological constants required in setting up extraterrestrial laboratories and habitations.

Discussion: Chernigovski was asked some 15-20 questions from the floor, the majority of which had no reference to the material which he had read. On two occasions, he rather testily reminded the questioner that he had made no mention of the matter contained in the question during his presentation. In those cases where he did answer the questions, he did so in very general terms as the following few examples will illustrate:

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- Dr. Bernie Wagner, U.S.A., asked him if he foresaw a continuing need for studying primates and other sub-human species in actual space flights and his answer was that all animals can and should be used depending upon the problem under study.

- Dr. Stan White, U.S.A., asked his opinion on the relative role of emotional excitement and actual metabolic needs in accounting for the high respiratory rate observed in Leonov during his EVA and Chernigovski answered that both factors played a part.

- Otto Gauer, Germany, asked him if they had made any studies on water balance mechanisms pre- and post-flight on their cosmonauts and his answer to this was that all of the cosmonauts and astronauts have lost some weight during their flights and he (Chernigovski) personally related this to some alteration in their water balance.

13. Prof. G. M. Frank summarized a paper entitled the Combined Effects of Space Flight Factors on Some Functions of the Organism. This work reported upon was done entirely in the laboratory, using a variety of animal subjects. Primarily it was concerned with the study of central nervous system functional changes resulting from exposures to dynamic factors such as acceleration, vibration and irradiation. Animals were exposed to very short term vibrations and accelerations over a period of several weeks time with measurements being made on cerebral blood flow, electroencephalogram and electromyograms. All animals showed a definite reduction in CNS activity which persisted in the majority for as long as 12 days. Sub-clinical superimposed exposures to simple ionizing radiation combined with the dynamic factors gave no specific patterns of response as differentiated from those observed without it.

Discussion: Prof. Frank was noticeably more agreeable and friendly in answering the questions put to him. Klein, U.S.A., asked him what the centrifuge conditions were on the rabbits and the answer was that it was a small centrifuge with 5 G's at the head and 10 G's at the pelvis.

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Bartels, Germany, asked how the pO₂ was measured in the sensorimotor cortex area and Frank answered that it was done by means of an implanted polygraphic electrode. Tobias, U.S.A. asked if they had tried the reverse of their stated procedure, namely exposed the animal first to the vibrations and second, to the ionizing radiation, and Frank replied that they did not and that it was possible to end up with meaningless data if one attempted to try out all possible combinations of factors.

14. Prof. A. V. Prokovsky read a paper (on which he was not listed as co-author) titled the Effects on the Organism of Prolonged Exposure to Pure Oxygen (100 Days) at an Ambient Pressure of 103 mm Hg. The animals showed a steady slight weight loss until the 35th day was reached and then their weight remained constant for the duration of the experiment. Muscle mass was diminished presumably because of fluid loss and the overall metabolic process showed some alteration in terms of specific energy turnovers. It was not felt that either the reduced ambient pressure or the lack of nitrogen in the gaseous atmosphere were responsible for the changes noted, since the same changes can be induced in the control rate if they were subject to repeated irritations.

Discussion: Andjus, Yugoslavia, asked if there were any changes in body temperatures noted in the experimental animals and the answer was negative; the controls showed the same temperature variations.

Wood, U.S.A. asked if there was any increased incidence of atelectasis noted and the answer was negative but that the animals had not been subjected to any accelerations.

Culver, U.S.A. asked what animals were used and the answer was white rats.

Pollack, U.S.A. asked if they had attempted to correlate the weight loss with any specific alteration in the metabolic processes and the answer was that there was no additional information to be given.

Pace, U.S.A. asked him to comment on the relative merits of pure O₂ and a helium and oxygen mixture

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for use during manned space flights and the answer was that they had provided the cosmonauts with all the requirements for maximum comfort, namely an exact duplicate of their accustomed sea level ecology and therefore, the question of making any substitutions had never risen in their case.

15. Professor G.M. Frank gave a short eulogy for Prof.A.V.Lebedinsky, one of the authors who died recently, and then read a paper entitled Criteria for Radiation Safety in Prolonged Space Flight. This particular paper represented the most scientific and objective piece of research work reported on in this Symposium. It was not summarized but read in detail and it certainly merits careful perusal by anyone interested in the field of space radiobiology. It deals primarily with extensive studies made upon dogs, rats, mice and some plants to determine more accurately the true RBE of variously energized protons. In addition, it reported on a series of 600 rabbits which were exposed to various doses of Gamma radiation to study the effects upon their vestibular apparatus. They found that exposures of 50-100 rads increased the sensitivity of the vestibular apparatus within a space of a few hours, whereas doses above this level decreased the sensitivity. The interesting point was made (and for the first time by the Soviets, to my knowledge at least) that although under ordinary circumstances 5 BER (REM) was an acceptable annual dose for people in normal terrestrial life, the very nature of manned lunar exploration with its concomitant factors i.e., mission importance, few people involved, one time lifetime exposure, etc., allowed us to set higher exposure dosages for the cosmonauts involved. He categorized these exposures as (a) permissible - 15 BER, (b) justified risk - 30 BER and finally, a critical risk at 50 BER (the latter considered as the level above which one could expect to get some immediate functional changes). In terms of the total duration of a lunar flight, they were thinking of a fifteen day period.

Discussion: Connie Tobias, U.S.A. paid tribute to the great work done by Prof. Lebedinsky and the seriousness of his loss to the scientific community. He then made the following comments: Along with the skin and eyes, which get a considerable surface dose with every solar flare, it is important to consider the effect upon the immunological mechanisms of the body. Bone marrow

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machine interactions and communications.

Discussion: none

17. Professor Vasilyev presented a very nice, compact summary on Some Results of the Medical Investigations during the Voskhod Spaceship Flight. He pointed out that the presence of the physician, Yegorov, (which has been emphasized before in both the Soviet lay and scientific press) enabled them to make a big advance in the amount of new medical knowledge gained from space flights. He was proud, he said that Yegorov performed all of his assigned tasks in excellent fashion and the detailed results were not being carefully analyzed for a further more detailed report. He continued, pointing out that the second most important factor in gaining useful medical information was due to the fact that the crew for the first time did not wear the bulky space suits all of which led to much more comfort and less expenditure of wasted energy. The maximum weight loss observed in the crew was 3 KG and they felt that this was accounted for by the sweat loss. In his opinion, the excellent performance of the crew was due to the thoroughness of their training plus the 'neuropsychiatric conditioning' which they received prior to the actual flight. Yegorov had some unpleasant dizziness when he moved his head quickly but he learned to move slowly and deliberately when he was performing his work. All showed a 20% increase in energy expenditure over terrestrial control levels during the flight and all showed unmistakable evidence of exhaustion post-flight, which however, disappeared within several days. Post-flight indices related to stress correlated directly with the degree of responsibility placed upon the crew member; Komarov, the pilot with greatest responsibility, showed the most evidence of stress reaction with Yegorov second and Feokstikov last. He closed with the observation that 'our findings confirm the hypothesis that emotional factors control the total reaction pattern to the total experiences and stresses of space flight'.

Discussion: Too many questions were asked to identify each questioner.

- Was Leonov disoriented during his EVA?
Answer - Neither one was.
- Can you explain Yegorov's dizziness?
Answer - Not adequately.

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- What were the urinary outputs?
Answer - Not measured.
- Can you discuss the state of exhaustion in more detail?
Answer - You use the term 'exhaustion' differently than we do; all three were tired and weary but well able to get about and respond normally.
- What do you mean by the term 'greater reactivity observed post-flight'?
Answer - Resting and exercise pulse and breathing rates were higher post-flight than their control values and these required three days before returning to previous pre-flight values.
- What physiological parameters were recorded inflight?
Answer - I have already told you in the report I gave, you can read it later.
- Were changes in blood chlorides measured?
Answer - Yes, on the second and fifteenth orbits.
- Any changes in calcium metabolism noted?
Answer - Not significantly.
- How do you account for the 20% increase in metabolism?
Answer - Emotionality of the situation, as I have already emphasized.
- How was the blood sampling done?
Answer - Micro methods collected on filter paper and stored in special containers for post-flight analysis.
- What limitations in flight duration do you believe are imposed by zero G?
Answer - We have studied man in zero G only for five days (Bykovsky) and we cannot predict beyond that time period.

13. Prof. Buser of CERMA, Paris, France, presented what to me was a rather poor paper, entitled Electrocoricographical Activity in Different Phases of Flight in Planes and Rockets, although I was because of my relative ignorance of the field be doing him and his group an injustice. He cited the appearance in the rat and cat of high amplitude, low frequency spindles shortly after zero G state was reached but other factors such as sensory isolation may be involved. The appearance of these spindles cannot yet be related to demonstrable behavioral changes in the animal.

Discussion: none

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10. The Soviet paper dealing with Problems of Man's Reliability in Spacecraft Control Systems was presented by Dr. V.A. Popov. This particular presentation again, as in the case of Chernigovski's, was on man-machine interactions in a somewhat philosophical vein with the complex problem of integrating and optimizing the man and machine functions in the operation of the space vehicular system. He pointed out that since all machines (and components) are conceived by the human brain, it should be possible for man to develop and maintain the knowledge necessary to effectively and economically control the equipment. Since Yegorov had been required to expand one and a half times the effort to do his job in space as he had on the ground, it is obvious that we have by no means solved this man-machine interaction problem yet, even in our first family of space systems. This particular problem of space flight demands and merits the best talents of the flight surgeon, the engineering psychologist, the equipment engineers and representatives from other disciplines and, in truth, it can be regarded as the primary challenge of space-flight demanding a true interdisciplinary approach. Initially, one must demand from the engineers a degree of reliability in the equipment which far exceeds any previous standards or requirements, for anything less than optimal will automatically reduce the time allocated by the cosmonaut for 'purposeful' activity. Next, we must create a variety of models in which the tasks to be performed are shared in various different configurations between man and the equipment. Finally, after our studies have indicated which of these various model configurations appear to best satisfy the particular mission requirements, then we must construct from the model, a computer-simulator which will faithfully reduce under ground conditions, all of the routine and emergency situations which can be met by the man-machine combination in actual flight. From this then, the final details of the time-task sharing between the man and his equipment can be developed and refined, and in addition, training requirements for the actual mission can be delineated and quantified.

Discussion: Grandpierre, France, asked what specific patterns of activity were established during the simulation (of the Voskhod) flights. Answer - Principally the change in the amount of time needed to perform critical tasks during the first few hours of flight and further along with this, to establish reproducible patterns of accurate performance.

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Graybiel, U.S.A. questioned how much help Leonov received from the tether in keeping himself oriented with the spaceship during his EVA. Answer - The pilot, Belyaev, was constantly in touch with Leonov who at no time required any assistance. He did not have to rely on the tether for his spatial orientation. (This contradicts other statements).

Campbell, U.S.A. asked if Popov could explain the violence of some of Leonov's movements during his EVA. He replied that this was partially due to the euphoria of the situation.

Lampert, U.S.A. asked if he would describe in greater detail the characteristics of the tether. Popov replied that it was simply a strong lifeline between Leonov and the spacecraft, carrying with it only the telephonic wire communications link with Belyaev in the spacecraft.

White, U.S.A. stated his interest in the work which Popov had reported in his paper and asked if he could cite some practical applications of this approach as regards the actual Voskhod flights and further, he would be interested to know what measures were used to determine the relative degrees of proficiency exhibited by the individual cosmonauts during their training period. Popov answered somewhat vaguely, saying that in answer to the first question he could only say that the final interface developed in the Voskhod's were arrived at through mathematical assessments and to the second, it was a very complicated question.

20. Dr. Marianne Frankenhouser, an experimental psychologist from Sweden presented, in a very precise manner, the results of a study on the Physiological, Behavioral and Subjective Reactions to Stress. Using a relatively small (statistically) sample of human volunteers exposed to laboratory-designed stresses, i.e., centrifuge and electric shock, she attempted to show a direct correlation between subjective reactions, proficiency of performance and catecholamine excretions. Her findings would lend support to the highly controversial hypothesis that high scores on personal in-

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ventory and motivational tests are directly correlated with proficient performance and high levels of noradrenaline during exposure to simulated stress conditions.

Discussion: Despite the general attitude of skepticism with which her paper was received, and perhaps because of her very evident depth of sincerity in her approach to this old problem, most everyone refrained from asking embarrassing questions on the several weak points in her experimental design. Novak, Czechoslovakia, was ungallant to the point of observing that he rather doubted the re-producibility of her findings, and even if such could be done, he could see no direct practical applications of the work in spaceflight. His untimely remarks did not disturb the composure of the middle-aged but still blonde and pretty Dr. Marianne and instead only rewarded him with a number of dark and menacing looks cast in his direction from the male delegates surrounding him, all of which terminated the discussion period on a fairly polite and gentlemanly note.

21. Prof. A.M. Guenin concluded the U.S.S.R. presentations with a very excellent workmanlike paper entitled A Physiologic and Hygienic Evaluation of Life Support Systems in the Vostok and Voskhod Spacehips. Initially, Guenin emphasized the point that all life support systems used in the Vostok and Voskhod series were carefully designed to fit the metabolic, comfort and safety requirements of the crew as directly related to the mission duration and tasks to be performed for each specific space flight. Additionally, these systems were mocked-up in exact duplication of the flight articles and tested extensively on the ground, using the selected cosmonauts as the subjects. In computing the energy-metabolic balance equations, they were mindful of the fact that during the first twenty-four hours of every flight, as the result of the increased excitement of the cosmonauts, adequate allowance was made for the above-normal energy requirements. In general, their design criteria were based on an average of 220 KCALS/hr being expended during the periods of wakefulness and 70 KCALS/hr during sleep. Their regenerative environmental control systems were both automatically

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and manually controlled; were designed for twelve - fifteen days duration on the Vostoks and for approximately thirty days duration on the Voskhods. Both were fitted with emergency, redundant back-up systems in the event that any temporary overloads into the system were encountered. As a general concluding statement, he observed that the life support system for both types of spaceships had performed exceptionally well and had indeed exceeded their initial hopes and expectations.

Discussion: Johnson, U.S.A. asked whether or not their initial studies of energy exchanges had indicated a difference between the cosmonauts working with or without the encumbrance of pressure suits. Guenin replied that the metabolic profiles recorded on the Voskhod cosmonauts revealed a higher energy expenditure than those in the Vostok series, despite the fact that the former were not wearing pressure suits, but he feels certain that this was entirely due to the fact that they were much more physically active (and mentally also) than those in the Vostoks.

White, U.S.A. asked if they had experienced any difficulties in waste management and Guenin answered that they had some considerable pre-flight concern regarding the possible build-up of carbon monoxide and other noxious gas by-products of human metabolism and they consequently placed special filters in the cabin regenerating air circuit to completely oxidize these by-products. During the actual flight, these various contaminants were measured and in no case did they exceed the MAC levels which had been set for safe and comfortable occupancy. He added that the human waste, both solid and liquid, was all collected in a separate isolated system which was in no way connected with the regenerative environmental control system of the space cabin.

Pace, U.S.A. asked Guenin if he would discuss in greater detail, the food and water consumption of the cosmonauts in relation to their activities and any periods of excessive temperature rise in the cabin. Guenin replied

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that the type and amount of food intake varied considerably with the individual but on an average, the cosmonauts intake measured about 2500 Kcals/day. Fluids were largely taken in the form of fruit juices and the actual consumption of total water, including that accounted for in the juices and food, was less than they had calculated. He has no ready explanation for this except that the cosmonauts seemed simply to be less thirsty; certainly they had ample supplies of water aboard and were not enjoined to conserve on their supply. As far as any uncomfortable increases in cabin temperature were concerned, they never occurred because of the large redundant capacity for cooling which was built into the environmental control systems.

Johnson, U.S.A. asked Guenin if he would kindly elaborate on the functioning of their two gas ECS and specifically, discuss such things as mechanisms for monitoring and control of the two gasses; the pressure leakage rate in the capsule and the amount of nitrogen which had to be added per twenty-four hour flight. Guenin listened very carefully to the interpreter and then replied that their system was a fairly simple one and extremely reliable. They monitored the gaseous cabin mixture by means of a portable gas analyzer and that there was no requirement to add nitrogen (or be concerned about any pressure leakage) since the cabin was completely hermetically sealed, had no leak rate and therefore there was no need for adding nitrogen.

22. The high point of the American presentations, at least as far as the Soviets were concerned, came at mid-afternoon on the last day when Dick Johnson, U.S.A. NASA, gave a very excellent summarization of the Gemini 4 Flight with special emphasis on White's extravehicular activity. As his final coup de grace, Johnson showed an excellent colored film of White's Walk in Space and the Soviets were visibly and audibly impressed, particularly with the self-propulsion device which had been used with considerable success. Because of urgent requirements to meet our incoming astronauts, McDivitt and White at the American Embassy, Dick Johnson apologized

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for not being able to stay for the discussion period and left UNESCO House. As he walked down the Symposium aisle towards the exit, the Soviet delegation, practically en masse, left their seats and intercepted him in the outer hall where they shook his hand and repeatedly congratulated him, not only on his presentation but also on the great feat accomplished by the Americans on the Gemini 4 Flight. He (Johnson) very graciously stopped to receive their congratulations, and in addition, opened his briefcase and passed out to them some colored still photographs showing White's Walk in Space holding the extravehicular propulsion unit along with some tie clasps designed to commemorate our first EVA. Both of these gifts were eagerly and gratefully received by the Soviets, and as several of them told me later that evening, they prized these two gifts from Dick Johnson far more than anything else they had received from the Americans during the period of their visit.

23. Since I also had some rather urgent requirements at my hotel in the form of making preparations for the informal cocktail party which we were giving the Soviet delegation and selected U.S.A. delegates at 1030 that evening, I left shortly after Dick Johnson departed, thereby missing the last two papers on the program given by Harold Klein and Don Rea. It was reported to me later that neither of the papers elicited much interest or comment on the part of the Soviets.

D. REPORT ON INFORMAL DISCUSSIONS WITH THE SOVIETS.

1. Preliminary Note

The conversational exchanges that are reported herewith took place at varying times and on different occasions; at two luncheons (Thursday and Friday), during some of the scheduled coffee breaks and at other odd moments during the proceedings of the Symposium when the immediate proximity of either Boris Mandrovsky or Mike Terpogossian made it possible for either myself or any of the Soviets nearby to initiate a conversation. The fact that the Soviets arrived at noon on Wednesday and seated themselves solidly along one row of seats which aligned them directly in back of the section where Herb Pollack, Al Mayo and myself had been sitting since the beginning of the Symposium, provided for a very handy and easy opportunity for

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the three of us to exchange pleasantries from time to time with our Soviet colleagues. This opportunity was further enhanced by the fact that Mike Terpogossian seated himself immediately behind me at the extreme left of the Soviet seating line with Prof. Vasilyev on his next right. Mike was extremely helpful to us and all others in providing, practically on call, an excellent scientific interpreting service for many of these spontaneous informal exchanges.

I am confident that the significant material contained in these informal exchanges has already been faithfully and accurately reported in all necessary detail. Therefore, rather than attempt to integrate the subject matter which I am reporting upon herein with the specific time and place at which it took place, I would prefer to report my communications with the Soviets on a specific topic basis. I would add herewith only one note of caution to the reader in assessing the validity of these reported exchanges and particularly of the personal opinions derived therefrom, for the very good reason that amongst the American delegation there are fairly strong differences of opinion regarding the integrity and substantive value of the Soviet conversational inputs. Although representing somewhat of a minority opinion, those expressed by Herb Pollack are most assuredly not to be treated lightly and he feels that the total exercise produced little of value in terms of our gaining any useful or significant information from the Soviets. If his categorization of significant and useful information connotes primarily specific and objective experimental data covering their mistakes, surprises and unresolved serious problems plus definite statements regarding future plans and events, then I would certainly have no argument with him over his contention. However, and at the same time, I must confess that in six years of dealing with the Soviets at these international affairs, I have yet to gain these types of information from them either from formal papers or during informal conversations. Actually, the only case which I should like to make on the occasion of this last exercise is that the Soviet papers given at this session were substantially better than those given on the previous similar occasion in 1962, and evidenced a considerable degree of improvement both in terms of substantive content and scientific data reported.

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Insofar as the informal exchanges and spontaneously arranged luncheons were concerned, there can be little doubt that the Soviets were much more open and relaxed on this occasion than on any others in the past at which I have been in contact with them. Not only did they evidence a new spirit of friendliness and willingness to meet with us and discuss matters of common interest informally, but what was even more surprising to me was the manifestation of their own eagerness and initiative in approaching individual American delegates, whom they considered their equals in certain areas, for the express purpose of discussing specific items in greater depth and detail than time had permitted during the formal proceedings. Although my personal gullability in this area of international biopolitics is a fairly boundless one, I nevertheless am convinced that they came to this Symposium with the sincere desire and intent to exchange ideas and data on a wider scope and in greater detail than ever before. Whether or not this was due to the fact that we had, as some people say, caught up with them in our successful Gemini flight is difficult to say. Other delegates at the Symposium, noting this change in the Soviet attitude, expressed the opinion that they have run into serious difficulties in their own program and believe that we may already have the answer to some of their problems. My own personal opinion is that this more friendly and open approach is based upon a number of factors among which the aforementioned two may indeed be predominant but, at the same time, neither one being the key to the situation. Rather do I believe that the opinions, judgments and expressed desires of the Soviet working scientists, vis a vis the obvious value of working more closely with us on a much broader bioastronautic front, has won over the previous political constraints that were placed upon them in dealing with us at the international biomedical front.

2. The Status of the U.S.A. - U.S.S.R. Bioastronautics Exchange Program.

This item is somewhat an extension of the subject discussed in the preceding several paragraphs and I shall herewith only fill in with several interesting details. Again, there can be little doubt but that the Soviets came to this Symposium with the objective of improving our bioastronautic exchanges to a considerable degree,

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and from their conversations on this matter it certainly seemed apparent that they not only had Prof. Gagenko's approval to make definite approaches to us but actually had his active support and encouragement to come out of the meeting with some fairly specific mutually agreed upon plans for future improvements.

Pokrovsky, third ranking member of the Soviet delegation and probably the senior in terms of operational aeromedical experience, brought up this subject with me in a fairly forceful and direct manner on the occasion of our first luncheon together and between himself, Popov, Vasilyev and Guenin, I was repeatedly gigged and prodded on this subject on up to the time of our farewell dinner together. Their combined arguments and views ran somewhat as follows:

- If we worked more closely together and pooled our knowledge, skills and resources, directing them toward an all-out attack on some of the more complex and difficult problems, we would likely come upon a satisfactory solution in a far shorter time than if we go our own independent ways.
- Despite their best efforts and intentions expressed at the international space bargaining table, we Americans have consistently dragged our feet on reaching any satisfactory agreement vis a vis the establishment of a workable bioastronautics exchange program. Needless to say, I countered this ploy with every argument within my cognizance, some factual and some fictional made up on the spot for the occasion, but to no appreciable avail.
- The COSPAR meetings were fine as far as they went in the direction of exchanging very basic space biologic and exo-biologic information but they had not proved very useful for the purpose of establishing a basis for exchanges in the more applied field of space biomedicine, especially that dealing with manned spaceflight activities and problems. Besides all this, the Soviets emphasized

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the point several times that COSPAR was strictly government directed and controlled and therefore did not represent a workable scientific and engineering interface in the true, traditional sense of the word. (Needless to say, if the COSPAR Secretariat, some members of the Space Science Board or some members of NASA read this, I shall be ridden out of the District on a rail).

- It is exceedingly difficult for them to understand why leaders in our space medical community such as Dr. Lovelace and myself, who have visited their country and have had many opportunities to observe their work, have not dealt with this problem in our own country with greater purpose and activity.
- While admitting that some areas of both of our space programs contained information of potential military value and therefore had to be classified, they stoutly maintained that the vast bulk of the biomedical science and engineering data which we were concerned with could easily be dealt with in a completely open manner.
- As a continuing and corollary thought to the question regarding classification which was briefly alluded to in the preceding paragraph, the Soviets suggested that if we in the U.S.A. found ourselves hemmed in with restrictions because we were using the term space or bioastronautics to characterize the field of scientific and engineering endeavor in which we wished to establish an information exchange program with them, perhaps it would be provident to categorize the field as aviation or environmental medicine in order to avoid all of the bureaucratic constraints imposed by that magic word 'space'. In furtherance of this thought and approach to the problem, they raised the interesting question of why we did not extend the activities of the Aerospace Medical Association on an international basis which, of itself alone, might well provide an extremely useful base and medium by which we could set up a well-organized program of scientific and engineering exchanges. I countered this statement by pointing out that the ASMA

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was not truly an international society, in that it did not directly sponsor and support any international meetings. They also added as a sly aside the fact that none of the Soviet aeromedical workers had ever been specifically invited to attend or present papers at our annual meetings, and interestingly enough, I find that they are quite correct in this statement. For some reason, and perhaps because of its strong military membership, the ASMA has largely gone down the line of NATO and SEATO nations in extending courtesies and invitations to foreign flight surgeons. At any rate, they made their point and I could only logically counter with the statement that I would investigate the problem further with the powers-that-be in the ASMA.

At the time of our final confrontation on this particular problem which took place on Friday evening, the Soviets and specifically Dr. Pokrosky, asked that I explore the various possibilities which we had discussed and communicate with Prof. Gzenko, through the Academy of Sciences or the Committee on Exploration of Space, on any and all ideas that we might have on both the subjects of future Symposia and the establishment of an organized effort which would insure a more useful exchange of bioastronautics information.

Upon my return to the States, I spent considerable time and energy writing up various plans of action which could answer the Soviet requests for proposals from us on both the questions involved, namely, the continuation of the International Symposium on Environmental Problems of Man In Space, and the setting up of a program for a better exchange of bioastronautic information. I asked Gene Konecni to form a Working Group under the auspices of the Long Range Planning Committee of the Aerospace Medical Association (on which I am the current Chairman) to deal with the latter problem and I organized an ad hoc group of U.S.A. delegates to the Paris Symposium for the purpose of reporting to Dr. Lovelace on the results of the Symposium, and also to give their recommendations regarding future similar meetings. Although both of these objectives have been accomplished in terms of the organization of effort, the net results thus far have been somewhat disappointing. Dr. Lovelace

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appears to have minimal interest in the future of the International Bioastronautics Symposia, or is so overloaded with work at his Clinic and with NASA that he simply cannot devote the necessary time such outside programs or projects require. Gene Konecni, meanwhile, is attempting to gather the loose ends together on the matter of the 1966 Third International Symposium on the Environmental Problems of Man In Space, and is working through Randy Lovelace and Stark Draper, come up with a package of several likely plans which can be submitted to and discussed with the Soviets during the period of the IAF Congress in Athens in September, 1965. Dr. Konecni also is working on the problem of the revised and enlarged USA-USSR Bioastronautics Information Exchange Program but on this item he is being held up pending the next meeting of the U.N. Committee on Space Activities which is scheduled to meet in New York the latter part of September. As I understand it, this question of the Bioastronautics Exchange Program will come up again at this meeting with Konecni (and perhaps someone from NASA) representing the U.S.A. interests and Gagenko representing those of the U.S.S.R. This meeting at the U.N. will, of course, come after the IAF Congress in Athens so it is not likely that any formal type of discussion or planning can be entered into with the Soviet delegation on this latter occasion.

3. Selection and Training Philosophies and Procedures.

It is difficult for the Soviets (Popov and Vasilyev) to believe and understand why none of our astronauts have ever experienced even transient periods of disorientation, particularly when they first change from powered to free flight and zero G. I pointed out to them that perhaps it was because our criteria for selection were considerably higher than theirs in that, at least on the first several go-arounds, we required our candidates to be professional test pilots and further emphasized my point by stating that the rigorous training demanded of a test pilot was of itself an automatic screening device, since only those men uniquely adapted to effectively handle the unexpected could ever successfully complete the course. I asked Vasilyev if he did not think it somewhat significant that Tereshkova, Yegorov and Feoktiskov all had unpleasant vestibular reactions to weightlessness and none of the three had any background in test-piloting, or even flying for that

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matter. He readily admitted that an extensive high performance flying background did give the would-be cosmonaut a distinct advantage and further stated that, in retrospect, he thought we had been very wise in maintaining our own selection standards at such a high level. I then asked him if he would like to be quoted on this opinion and he said no (with a grin), that such would not be possible since it did not reflect the consensus of opinion of his superiors, all of whom were fairly well committed to the philosophy that any good healthy Soviet (male or female) could become a cosmonaut with proper training.

According to Popov and Vasilyev, the Titov experience shook them all up fairly considerably and made them stop and take stock of the whole situation. Quite an extensive series of conferences were called with many inside and outside experts being called in to give their evaluations and recommendations on the problem. Opinions were divided on the seriousness of the issue but not evenly so, with the older and more experienced aeromedical hands giving the majority opinion that Titov had an individual, unusual susceptibility to vestibular disturbances which somehow had not been detected during the training period and therefore the training devices should be drastically re-oriented to provide a better opportunity to quantitate this factor of individual tolerance levels. The Cosmonaut Bykovsky was then in active training and participated in many of these conferences, contributing perhaps as much or more (according to Popov) to the eventual success of the re-oriented training procedures as anyone else. He (Bykovsky) being an extremely eager beaver, and somewhat worried that all this finking-out on the part of Titov might slow down the program, sold the doubting doctors and physiologists on the idea that by following a prescribed set of exercises he could demonstrably and significantly increase his tolerance to disorientation phenomena, and subsequently proved his point to a degree that surprised even their most advanced and radical thinkers. Popov said that most of the exercises which Bykovsky proposed i.e., swinging, rapid turning on his vertical axis (ballet dancer), tumbling and rotational exercises on the horizontal bar, etc.) were incorporated into the formal training program and all subsequent cosmonauts have followed the routine.

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However Popov pointed out that Bykovsky himself would carry these exercises to the extreme, doing them many more times than actually required and each time they would check his vestibular function, it showed always a slight but definite improvement. Bykovsky apparently at no time in his flight had any signs or symptoms of vestibular dysfunction.

Both Popov and Vasilyev are utterly convinced that 99% of the success of the space mission (barring a major catastrophe) is or can be assured prior to actual launch through the medium of continuous training in various types of simulators which duplicate in exact detail all routine and emergency events which can possibly occur during the planned mission. Of great importance also is the strict adherence of the trainee to the particular work-eat-rest cycle which they establish for each mission, disciplining themselves so strongly in the routine that everything practically becomes rote and instinctive to them. They feel that the whole field of training and simulation has almost limitless possibilities in terms of pre-conditioning and pre-adapting the human organism to perform unusual tasks with high proficiency under conditions of psychophysiologic stress which are thought now to be considerably beyond acceptable tolerance levels. However, on the matter of using drugs to assist the naturally induced adaptive mechanisms, they are somewhat less than enthusiastic except for the area of radioprotective pharmaceuticals.

4. Advances in Biotelemetry and Biotechnology.

There was not a great deal of informal discussion on the matter of biotelemetry and advances. In those cases where any reference was made to it, the answers were given in pretty much the same general type as have appeared in their publications. Vasilyev believes that their present seismocardiograph, recorded in real time correlation with the cardiophone and EKG, gives about as much information regarding dynamic cardiac activity as is possible under our existing knowledge and state-of-the-art technology. They are continuing to do a fairly extensive amount of work on this problem in their animal physiological laboratories but the problem always ends up as one of converting the animal work to useful and practical application in the space ship. They are definitely committed to the

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when discussing this problem with Prof. Parin, that the concept was fine, the only problem being that we did not know enough about the so-called 'normal' range of man's safe tolerances to really intelligently program the computer and they vigorously agreed with that opinion.

On the matter of the value of the EEG (electroencephalograph) tracings taken in flight, particularly from the standpoint of indicating relative degrees of fatigue and alertness, they had little to comment but did state that from a practical 'medical control' standpoint they felt that direct conversation by a physician, TV observation from the ground, voice communications with the ground, plus the electro-oculogram, the electromyogram and possibly the GSR, were of greatest value in the descending order of priority of the measures listed.

In the general area of Biotechnology, they felt that two areas in particular needed considerable attention, namely the further development of extravehicular suits and/or manned containers (non-anthropometric) and the development and flight qualification of truly regenerative environmental control systems. Although they are doing considerable work on biologically closed systems, they do not feel that these are practical, at least in considering the next five - eight years of manned space flight. They feel that a more practical solution can be found in developing an electro-thermal analogue of a partially closed biological-ecological system but did not elaborate further, at least in my presence.

5. The Zero G Problem.

Any expression of personal opinion on their feel for, and attitudes towards this all-encompassing space biomedical question is again fraught with considerable hazard since I suspect each individual (American) attempting to do so, can pretty much construct their remarks into a pattern which happens to fit his own view on the question. My own analysis and evaluation of their present situation is that they are not inconsiderably troubled and confused with the evidence currently at hand. I asked Vasilyev at luncheon the direct question - 'With all the knowledge you have on hand and given the aeromedical responsibility for saying go or no-go on a

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comfortable, non-invasive techniques of applying the sensors and are well-aware of the continuing requirement to gain the full cooperation of the cosmonauts on the matter of wearing and applying the sensors as well as carrying out any ancillary recording which might be required. In this matter, he again emphasized the great importance of wearing and becoming thoroughly accustomed to the wearing of his 'medical control' harness all through his pre-flight training period. I cited the previously published work by Bayevsky and Parin in which they presented their five phase theory on the reaction of the cardiovascular system to orbital flight based upon the results of the last four Vostok flights, and asked if the findings on the first two Vostok flights had added any confirmation to the advanced theory; to which I received a rather interesting answer as follows: Since both of the Voskhod flights were of relatively short duration, it was obviously impossible to study the full spectrum of the five phased adaptative processes but even so, with what data they had analyzed thus far it appeared fairly evident that the Voskhod cosmonauts did not display even in the initial phases, the same patterns of response as had been observed in the single-occupant flights. Particularly interesting to them was the fact that during the period in weightlessness, when their cardiovascular readings had reached a relatively stable state, there was no evidence of the so-called parasympathetic predominating influence (desynchronization of the electro-mechanical right and left ventricular events) which had previously been observed and described. I asked if this different finding could be explained by the fact that on the Voskhod flights the cosmonauts had been kept mentally and physically much busier than on the Vostoks, and they replied that, yes, such was distinctly a possibility but even so this deviation from the previous findings was difficult to understand and even harder to explain.

In discussing the 'next-step' advances which we should look towards in the field of physiological monitoring (medical control as they call it), they referred to again the same concept that Achaunichev had expounded in his paper given in 1962, namely that of having a small on-board programmed central computer which would analyze all inputs from the cosmonauts plus those from the cabin environment and transmit to ground stations only those data which exceeded pre-set values. I opined, as I had on a previous occasion

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opinions) may prove of some interest. From Popov's keen interest in certain aspects of our own program plus some rather extensive statements which he made on the subject, I believe the problem, from a human factors engineering point of view at least, of successfully completing an earth orbital rendezvous and assembly operation has then really buggered. How accurately the cosmonaut can effect this difficult maneuver with varying degrees of human and automatic control both in the command module and in the target vehicle plus the ancillary factor of ground monitoring, support and direction, is to them a very urgent and compelling question and problem. Somehow, I have the impression that they believe we have more and better answers to this problem than do they, and in fact this may be true. Popov (as well as Guenin and to a lesser extent Vasilyev) is very knowledgeable on this particular human factors problem and the depth and detail reflected in the extent and types of questions which he asked regarding our own activities on the matter of earth orbital rendezvous, attests quite adequately (to me at least) that this particular area of applied bioastronautics is receiving their greatest amount of interest and effort at the present time.

From both the formal and informal statements made by the Soviets, it appears evident that they consider the biomedical problems of manned lunar flight, exploration and return as being fairly complex, formidable and difficult to an appreciably greater degree than those encountered in short-term earth-orbital flight. As Prof. Frank put it, there are many more biomedical problems ahead of us than are behind us and at the current rate of rapid technological developments, this same situation is likely to persist for some time to come. In discussing the same subject, Prof. Poltrovsky pointed out that there are more than enough medical problems connected with the lunar flight to severely challenge the resources of both the U.S.A. and the U.S.S.R., adding the final observation that it was unfortunate that we two nations could not join hands and work together on man's conquest of the moon.

Any predictions as regards the nature of the Soviet space biomedical program to take place during the ensuing year can only be classed as pure conjecture, since at no time in the period that we were together did I hear any positive statements made on this subject. If one extrapolates into this future period from the pattern

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E. SUMMARY OF SOCIAL EVENTS AND ACTIVITIES

1. As has been noted previously, the Soviet delegates did not arrive in Paris until Wednesday morning and actually appeared at the Symposium at UNESCO House around 1130 on Wednesday. Therefore of necessity, they missed the first two social events which took place on Monday and Tuesday (and described below), but thereafter participated in those held on Wednesday and Friday evening. Since I left at noontime on Saturday for London, I do not know of any further formal or informal social events to which they were invited or attended. There was a statement made on Friday night by Prof. Frank to the extent that their particular group was unable to proceed back to Moscow on the coming Monday, as previously planned, because all of the available seats were being taken up by "higher dignitaries who had been in attendance at the Air Show". He added with a smile that this would compel them to stay over until Wednesday or Thursday enjoying the sights and food in Paris. There was also some talk about a few of the American delegates attempting to get together for a visit to the Air Show on Saturday with the idea of taking the Soviet delegates along and arranging a lunch for them at one of the American industrial chalets but to my best knowledge this particular plan was not implemented.

2. Traditionally in the past history of these kinds of affairs, the sponsoring agency usually hosts a cocktail party and reception for all attendees in much the same manner as the general mixer party is intended to get people introduced prior to the onset of business and professional activities in our own scientific and engineering societies. Such a party was given by UNESCO House in 1962 but on this occasion, apparently because of the restricted financial support being given to the Symposium by UNESCO and also by virtue of the lack of funds in the IAA till, the delegates were invited to a cocktail party sponsored by EUROSPACE. In addition to our own group, there was a much larger assemblage of dignitaries from aerospace industry on practically a global basis, although I did not recognize any Soviets in attendance, at least during the period of time that we were there. It was held at the Pavillon Dauphine, at Port Dauphine, Paris 16^{em} and quite some distance from UNESCO House.

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However, despite the transportation problem it evidently was very well attended by practically all of the Symposium delegates and liquor and food were in very abundant supply.

3. The reception and cocktail party which I sponsored was held on Tuesday evening, 15 June 1965 at our hotel, De France et Choiseul. In attendance were some thirty-six foreign delegates and twenty-eight from the U.S.A. As evidenced from both the immediate remarks and the amenities passed on to me the following day, it was by all standards a very excellent party lacking only the presence of the Soviets, who had not yet left Moscow, to make it a complete international success. Having been given the choice several months prior between Tuesday and Thursday nights to hold my party, I had chosen Tuesday for the principal reason of providing the earliest opportunity of getting the Soviets well-acquainted with our own delegates. This I had done at the previous Symposium in 1962 and it had worked out very well. Once having committed myself to this particular evening, it would have been impossible to change this to the later Thursday date without disrupting the whole delegation and their social calendar. In addition to this facet of the problem, there was the continued uncertainty as regards the exact arrival time of the Soviets which persisted until they actually showed up on the scene. Even as late as 1700 on Tuesday afternoon, we were told that they were momentarily expected at Orly Airport and might well arrive in time for that evening's festivities. During the Tuesday night party, a number of the American delegates came to me with the question of what we now could plan insofar as a scheduled social evening with the Soviets, if and when they did arrive. In response to these requests, I then went to Stark Draper, the President of the IAA, and asked if he would contact the senior member (presumably Prof. Chernigovski) as soon as the delegation arrived and ask them to fix a date on any of the remaining evenings, at which time we could arrange an informal cocktail and dinner party. Dr. Draper agreed readily to this plan and further agreed that we should attempt to restrict the participants from the American side to approximately the same number as there would be Soviets in attendance. The following morning Dr. Draper did meet with Prof. Chernigovski as soon as they arrived at UNESCO House and upon the latter's suggestion, finalized on the night of Friday for this smaller informal affair.

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4. The one official function sponsored by the IAA-UNESCO group for the Symposium delegates was held on Wednesday night in the form of a "pay-as-you-go" cocktail party and banquet. Early in the afternoon of Wednesday, the Soviets had stated that they would not attend the banquet since they had flown all the previous night and were pretty bushed. However at the end of the afternoon Symposium meeting, in saying their good-bys to some of the delegates sitting nearby, they told me that they would be seeing me that evening since they all had decided that they would like to attend the banquet after all.

The delegates were split up amongst the principal U.S.A. and foreign delegates with Professors Frank and Chernigovski sitting at the head table with Dr. Draper and other UNESCO and Academy dignitaries. We had Dr. Vorobriev at our table, since his command of English at this point is quite good, and there were nearly not enough interpreters to go around to provide one to each table where a Soviet delegate was seated. Actually, only Professor Frank and Prof. Vorobriev had sufficient command of English to enable them to get by without an interpreter close at hand. It seemed to me that Prof. Chernigovski had either forgotten the English that he knew at our previous meeting in 1962 or that he was simply not choosing to use it, for he had practically no complete conversation in English with anyone to my knowledge. The banquet was a rather dull affair with minimum of speeches, one of about three minutes comprising principally a welcome and good wishes on the part of the President, Dr. Draper, and the other about thirty seconds of response by Prof. Chernigovski, translated by Boris Mandrovsky. The address of welcome and the response bore little relation to each other as evidenced by the fact that whereas Dr. Draper emphasized the extent of collaboration which we had achieved in the field of aerospace medicine since the First Symposium in 1962 and foresaw a continued expansion in the future, Prof. Chernigovski, in response, simply paid tribute to the beauty of the feminine contingent in attendance and advised them to experience the delightful sensation of weightlessness in space but at the same time, he adjoured the menfolk to keep their feet solidly on the ground. With these comments, he sat down and resumed eating.

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Dr. Vorobriev at our table was quite animated and somewhat more gracious than he usually is, carrying on conversations with relative ease on a wide variety of insensitive subjects such as art, literature and so forth. He spent a fair amount of time talking with Marilyn, my wife, about his very pleasant visit in California as my guest and inquired of me about the health of my mother and others in the family. I asked him about Prof. Parin, saying that I had heard that he was ill and he said that indeed Prof. Parin had been suffering from thrombophlebitis which had given him a lot of trouble, but that he was attempting to keep his old laboratory schedule pretty much as he had done in the past. His affirmative response on this point of Parin's health was rather interesting to me since I had previously asked Prof. Frank the same question when I saw him immediately after his arrival around 1100, to which Prof. Frank had responded that "Parin was in fine health with no troubles whatsoever". Happily since the banquet on the whole was a fairly dull and uninspiring affair, with food and wine to match, it broke up early with the Soviets leaving en masse for their own abode. They appeared the following morning in very high spirits and well-rested, so I judge that they indeed had gone to bed after the banquet rather than going out on the town.

5. There was no listed formal or informal affair for Thursday night but the Grandpierre's (General and Madame) had hastily, on Wednesday afternoon when the Soviets arrived, issued invitations for a dinner party at a private club near Longchamps for what must have been most of the senior international delegates since we were invited. As it turned out, we declined with regrets and I have little knowledge of that particular social affair, and specifically, no knowledge of whether any or all of the Soviet delegation were in attendance. When Dr. Draper talked to me on Wednesday afternoon, after checking with Prof. Chernigovski on the matter of an evening being designated for our own dinner with them, he (Dr. Draper) had stated that the Soviets had chosen Friday because of an affair of their own which they had been committed to for Thursday. However, their plans can be changed quite readily depending upon their own inclination and it may be that at least Professors Chernigovski and Frank did attend the Grandpierre dinner.

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6. On Friday evening, the 18th, we had a cocktail party in our suite at the France et Choiseul which lasted from 1900 to 2045. All the Soviet delegates made their appearance and continued on to the dinner which was held at Chez Tante Louie, an excellent restaurant situated within easy walking distance on the Rue Boissy D'anglais. A total list of the attendees to both the cocktail party and the dinner is appended to this report.

There were two interpreters who were invited and did appear in the persons of Boris Mandrovsky of the Library of Congress and Mike Terpogossian, a radio-biologist from the Washington Medical School in St. Louis and consultant in aerospace medicine to the McDonnell Aircraft Company. I had asked Mike and Boris to be prompt in their appearance at 1900 because from past experience I knew that the Soviets would be there practically on the split second. Unfortunately, the Soviets did run true to form and all appeared promptly at 1900 but the main body of the U.S.A. delegation did not appear until around 1930 with Mike and Boris pulling in at the tail end. However Marilyn and I struggled with the Soviets as best we could, using Vorobriev as one point of conversation as interpreter and Prof. Frank as the other, but it was fairly stickygoing despite everyone's obvious willingness to be relaxed and friendly until our own interpreters made the scene. The conversations with the Soviets at both the cocktail party and the dinner were quite relaxed and open, as had been the case in our previous social encounters with them, particularly those of a spontaneous and informal nature. They made no attempt to form themselves into small groups and instead sought out specific individuals on their own with whom they desired to discuss further some of the technical and specific details which had arisen during the formal proceedings of the Symposium. This situation led to a considerable competition for the services of the two interpreters and we could have used several more very handily, since it became almost a case of one Soviet wanting to discuss a particular subject with one American and this obviously was impossible with only two interpreters being available.

Nothing formal had been planned for the cocktail party, nor for that matter for the dinner either, but there were several spontaneous gestures made which might be of some passing interest.

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Shortly before the 6:00 P.M. session was to begin, Prof. Frank asked me if there was any preliminary report available on the GT-4 medical investigations and results. I told him that I had been in contact with Dr. Charles Berry, Chief Flight Surgeon for NASA Houston, just prior to my departure for Paris and had received just general assurance based upon very preliminary findings on the matter, of the complete absence of any significant findings being listed on the astronauts post-flight examination. I further explained that it would be quite some time, according to Dr. Berry's estimate, before the findings would be produced, collated and issued even in preliminary form. Dr. Frank then asked how it would be possible for them to get a copy of the findings and I stated that the proper channel for him to go through to obtain such a report would be to write to NASA, to the attention of Dr. W. R. Lovelace, II. When I arrived back home at the apartment, I remembered that I had cut out of the New York Times and the Washington Post articles on the GT-4 flight which had been published both before, during and after the mission. The total amount of material was quite impressive, being about an inch thick in a manila folder. After the group had assembled for the cocktail party I rang the bell for attention, and using Boris as an interpreter, presented these newspaper clippings to Prof. Frank referring back to his original request, and stating that in the absence of a formal medical report, these clippings would provide him with a very accurate account of the entire flight proceedings, pointing out that in the U.S.A., our journalists are allowed complete access to all details of launch, flight and recovery and having been exposed over the past years during our space activities, had become very skilled in reporting accurately on our medical aspects and findings of each flight. In addition to these clippings, I gave Dr. Frank also the current issues of 'Newsweek' and 'Time', both of which had feature stories on the GT-4 flight. I realized that I had committed a slight breach of protocol in making the presentation to Dr. Frank and not to the senior delegate, Prof. Chernigovski, so as a partial act of retribution I presented him with a current issue of 'Playboy' which he accepted with quite appropriate pleasure and enthusiasm. It amused me somewhat that several moments later (after everyone had resumed their individual conversations and drinking), to have Prof. Frank come to me and raise the question as to why I thought he might not enjoy the 'Playboy' as much as Prof. Chernigovski,

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to which I replied that being partially retired I thought that Prof. Chernigovski would have more time to spend looking at the pretty girls in the magazine. However this reply did not appear to completely satisfy Prof. Frank's idea of an equitable distribution of the material which I had presented to them.

Once the cocktail party was well underway, I was cornered by Prof. Pokrovsky and Dr. Vasilev who were most eager to discuss in great detail the design, material construction and functioning of the EVA suit worn by astronaut White during his walk into space. I explained to them that, although I had kept fairly close contact with pressure suit developments since it was one of my principal interests when I was in the active Air Force, I doubted that I could give them any more details than what they had heard of the very excellent report presented by Mr. Dick Johnston of NASA. This reply brought forth from them statements of great commendation and high praise for both the actual feat itself and the excellent manner in which Dick Johnston had reported both the mission and the equipment involved. They were especially impressed with the simplicity of the maneuvering unit used. Dr. Isakov quite openly admitted that they were envious over our success with this unit and wished that they had been able to do the same thing on Leonov's walk. The other feature about White's EVA which seemed to impress them greatly was the fact that the decision to carry out this particular portion of the mission was made a relatively short time before the GT-4 flight and this fact was almost incomprehensible to them. Apparently in their own mission planning, Leonov's EVA had been cranked in quite some months before that particular operational flight was consummated.

We then got into a more or less general discussion of future developments in space suits and surprisingly enough we found ourselves in fairly complete accord on the following points:

- a. Further use of anthropomorphic "soft" pressure suits for EVA, directed toward orbital rendezvous assembly and repair, depended upon (to a large extent) the development of longer duration, more efficient (per pound weight) backpack and environmental control systems.

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- b. Thermo-meteoretic and ionizing radiation protective features had to be improved at the same time mobility to the critical skeletal joints had to be improved.
- c. The development of a satisfactory EVA suit for orbital operations would not necessarily imply that the problem of an adequate suit for lunar landing and exploration would be completely solved. They, the Soviets, are not willing at the present time to accept "a priori" the validity of an anthropomorphic "soft" suit configuration for lunar operations until more precise information is obtained regarding the lunar surface, characteristics and other information concerning radiation and meteoretic particle fluxes.

As far as the Soviets drinking patterns were concerned, they were true to form as on previous observations. Whereas Professors Chernigovski and Frank sipped on dubonnet until the last few moments of the cocktail party (at which time they tossed off a couple of vodkas in 'bottoms up' fashion), the rest of the Soviets stuck pretty much to whiskey. Vorobriev, as usual, drank nothing except fruit juice.

Initially the dinner had been planned and specified as an all stag affair, with the few wives who were present at the meeting, being in attendance only at the cocktail party. Marilyn had made arrangements to have dinner that evening with an old college girl-friend, who is currently working for Naval Intelligence in the Embassy, and they carried out these plans as per my original instructions. However, during the cocktail hour the question was raised by one of the other husbands in the American contingent, regarding the possibility of relaxing the rule and taking their respective wives along to dinner. Although not in favor of this, I nevertheless acquiesced, asking only that Dr. Draper be apprised of the change in plans and also that the sponsor of the dinner be notified in terms of picking up the tab. These things were accomplished and the Mesdames Pollack, Pace and Malina accompanied the party to dinner.

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The dinner period went off quite well with a moderate, continuing flow of alcohol in the form of cocktails, high balls, wine and champagne but there was actually less drinking and conviviality on this occasion than had been at the previous Symposium, when we had done basically the same thing at the same restaurant. I would certainly not be ungallant enough to say that the presence of the three wives detracted from the gaiety and spirit of the dinner, but I would be rather inclined toward the opinion that a stag affair would have been more conducive to further discussions on scientific and technical matters of mutual interest.

I had previously asked Dr. Draper to ascertain, if possible, the thoughts and desires of the senior Soviet delegates regarding the continuance of these Symposia and during the cocktail party he assured me that he had done this. His short informal speech at the banquet, in which he toasted the success of the Symposium with the hope that our future collaboration efforts would continue ever increasingly in scope, had concluded by saying that he had discussed the matter of continuing these meetings on into the future with Prof. Chernigovski, who had happily voiced complete concurrence to the idea. Dr. Draper continued further to say that on the basis of informal discussions with various and sundry delegates during the proceedings of the current Symposium, he had made his own judgment to the effect that we should strive toward bringing these meetings off on an annual basis. At this point, Dr. Cornelius Tobias of the University of California, Berkeley, called for the floor and made a stirring plea to hold the 1966 Symposium in San Francisco. The West of the Mississippi contingent applauded this suggestion so enthusiastically that the proprietor came running upstairs to see if everything was alright. Prof. Chernigovski, in his very brief response to Dr. Draper's informal speech of welcome and congratulations, seemed somewhat out of the spirit of the occasion, particularly as we had known him at the time of the previous dinner in 1962. His remarks were extremely brief, simply thanking those who were responsible for the pleasant evening and gave assurances of their continued participation in future similar enterprises. Shortly after the coffee had been served, and at a time when most of us thought that we could settle back for a little relaxed business type repartee with


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our Soviet colleagues, one of the wives who was sitting next to Prof. Chernigovski got up in order to pay a visit to the powder room. Whether by design or default, Prof. Chernigovski mis-interpreted her departure as an indication that the evening's festivities were at a close and he chose this instant to signal the departure of the Soviet group. I had the impression that a number of the younger Soviets, who were sitting some distance from the Professor, were somewhat surprised at this early departure but responded with understandable alacrity when he made the move. The good-byes were said all around and appeared to be accompanied by very friendly feelings between the two groups. Prof. Chernigovski, as he passed me, stated that they were all very tired and needed a good nights rest, after which he gave me the big bear hug and took off with his charges. The party largely disbursed with the exception that Doctors Pollack, Graybiel and myself, along with Boris Mandrovsky, stayed behind to sip a brandy and exchange impressions on the attitudes and intentions of the various Soviets in attendance. We were all fairly impressed with their apparent sincerity in wanting to establish a better means and/or medium which could serve as an open channel for the exchange of information on aerospace medical matters. We discussed briefly various possibilities, various agencies and various plans which might be brought to bear toward a better resolution of this problem and agreed that, if on no other basis than purely one of personal interest, that we would inter-communicate with each other and some other aerospace medical workers, whom we felt were knowledgeable in these matters, and attempt to come up with some workable plan in the very near future. For my part I told them, that since this particular question had been assigned as a task for the Long Range Planning Committee of the Aerospace Medical Association, that I would put together my thoughts and recommendations in the form of a letter to the current President of our Association, Dr. Neal Baxter. (N.B. This has been done and distributed as of 29 June 1965).

This marked the end of the formal and informal activities of the Symposium, at least to the extent of my own participation. Insofar as the social activities were concerned, in retrospect I feel that with the two to three day delay imposed upon the Symposium

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proceedings by the late arrival of the Soviet delegation, that all things subsequently worked out in an optimal manner in terms of informal and social events as could have been hoped for.

7. Upon returning stateside and conferring with Herb Pollack, Al Mayo and Boris Mandrovsky, I learned that on Saturday they had toured the Paris Air Show with the Soviet delegation, spending most of the day together and ending up having dinner together at the Cafe de la Paix. With the exception of the period during which the party was observing the Soviet exhibit, our men stated that their Soviet counterparts exchanged ideas and information quite freely and apparently a number of specific points in previous questions were fairly completely clarified in the minds of Herb Pollack and Al Mayo. According to Al, Popov described in great detail not only all of the protective gear which Leonov wore during his EVA but also described the program of activities which he was to perform, including the maneuver involving the suspension of his tether which he failed to accomplish. Herb Pollack pursued some questions which were left in his mind concerning their metabolic studies which were performed before, during and after the two Voskhod missions but during my brief telephone conversation with him I did not get the details on the specific points which he had raised with them and subsequently were answered to his satisfaction.

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